XI. *Observations on some Peculiarities observable in the structure of the Gannet,* Pelecanus Bassanus. *And an account of a new and curious Insect, discovered to inhabit the Cellular Membrane of that Bird.*

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(Read 16*th July* 1808.*)*

Among the animals whose various peculiarities of structure appear out of the common course of nature, the Gannet claims particular attention.

Having made a longitudinal incision from the breast to the vent of a Gannet, in order to prepare it for preservation, I was struck with the appearance of several pellucid bodies, by which the skin was connected with the body. This circumstance brought to recollection the fact related of thepelican, by Buffon; who remarks, that, from the lungs, the air passes through axillary pipes, into a thick vesicular cellular membrane that covers the muscles, and envelopes the whole body. The structure, however, of the gannet, although probably intended for similar purposes, is very different from that of the pelican, according to the relation of that naturalist.

The gannet differs materially from its congeners, the Corvorant and Shag, in being extremely buoyant, floating on the surface of the water like a gull; whereas those species of *Pelecanus* sink deep in the bosom of the water: it is therefore reasonable to conclude, that the gannet, like the gull, is incapable of immersion, and consequently cannot pursue its prey under water*.

During the season that they frequent the British Channel, they are easily captured, as they rise with difficulty, unless against the wind; consequently by keeping to windward, they are readily run down by the assistance of two or three boats, for they never attempt to evade their pursuers by diving, (from which it is natural to infer they are incapacitated for diving) ; but they defend themselves most obstinately, when about to be seized.

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* The leg-bone or *tibia* of the gannet is remarkably broad in front, not compressed, as is usual with those birds who pursue their prey under water. The serrated middle claw cannot be indicative of its habits, since many land-birds are equally furnished with a similar formation, the use of which has never been discovered.

The bill of the gannet differs from that of most birds, for it is not only destiture of nostrils, but on each side the upper mandible towards the base, is a dentation that divides the margin, and thus admits of a considerable motion. The eye is protected by an unusually pellucid nictitating membrane, that at once guards that delicate organ from the common accidents incident to its habits, and at the same time admits of a sufficiency of light for all the purposes of vision. This circumstance has been noticed by several authors ; but those who affirm that the gannet possesses a dilatable pouch, like the pelican, under the chin, of a size sufficient to contain five or six herrings, cannot have examined that part with due attention. The œsophagus, it is true, is extremely capacious, and the skin of the throat and neck is equally capable of distention, so that five or six fishes, of the size of a herring, might be contained in the gullet and stomach ; for there appears to be very little difference between them, or in other words, the stomach is a continuation of the œsophagus with little or no stricture or division.

It is well known, that many birds regurgitate with much ease and facility ; and that instinct points out to them this mode of preparing the food intended for the nourishment of their young, in the receptacle, usually termed the craw : in this manner, the gannet can readily disgorge the contents of its stomach, (for it has no craw), to satisfy its young.

Having taken a cursory view of the natural habits, and the more striking external appearances of this bird, I shall proceed to detail my observations upon the more occult properties with which it is endowed, and which are apparently so admirably adapted to its mode of life, and continued residence on the waters, even in the most turbulent sea, and most inclement season. I must, however, candidly acknowledge myself inadequate to the task of a minute, anatomical disquisition, and must therefore claim the indulgence of the zootomist, or comparative anatomist; requesting such to bear in remembrance, that I am only stating circumstances as they have occurred; my object being to stimulate others, better qualified to dissect, to detail their anatomical observations upon this singular bird.

By comparative anatomy, it has been clearly demonstrated, that birds in general are provided with air-vessels in different parts of the body, and that many of their bones are not destitute of this contrivance, admirably fitted for increasing their levity, and consequent buoyancy, as well as progressive motion through that element in which they are intended principally to move, and that too with a velocity that far surpasses all the other parts of animated nature. Mr John Hunter, in the

"Transactions of the Royal Society," proves, that the air-cells, in the parts already mentioned, have a free communication with the lungs by means of openings on their surface, through which the air passes readily into them; and it clearly appears, there is no diaphragm that confines the air to the regions or cavity of the breast, but that the whole of the abdomen is equally inflated by inspiration through the lungs.

Thus far has the scientific researches of that anatomist contributed to our knowledge on this subject; but we may presume, much remains to be done. No one appears to have noticed the phenomena attendant on the construction of the gannet, or to what further extent this circulation of aerial fluid is carried in some particular species of birds; a circumstance which demands our highest admiration, when we contemplate the advantages which such a structure may be of, in conducing to the comforts, and perhaps to the very existence of such animals.

Several gannets having been subjected to artificial inflation, I shall state the result, and relate the manner in which the experiments were pursued. A pipe was first introduced into the trachea, and when air was propelled through it, the whole internal cavity of the body was inflated, but no air passed into the external cells between the skin and the body. An incision was then made in the lower part of the abdomen into the body, very near the vent; air was forced through a pipe introduced at that part, (the pipe in the trachea having been previously stopped), and a similar inflation ensued without affecting the exterior cells. The pipe was now removed from the trachea, and, upon the air being propelled with force through the pipe at the vent, it readily found its way through the larynx, producing a noise similar to the sound emitted by the living bird. A small opening was then made in the skin on the left side, about mid-way between the wing and the thigh, and a pipe introduced, having first stopped those directly communicating with the internal parts, it was obvious, that when air was forced through this orifice, the skin on that side, as far as the middle line of the body, was greatly inflated, and it extended into the lower part of the neck, along the larger joints of the wing, down the thigh, and also into the cavity of the body, but the right side was not in the least affected: the pipe at the trachea being removed, the air produced a similar effect upon the larynx as before mentioned, but not so loud. Still suspecting there was a communication between the sides, by means of some valvular apparatus, the right side was subjected to the same experiment; but the result negatived my expectation, the effect produced being similar in every respect.

From a repetition of these experiments upon several subjects, it became evident, that there was a communication between the lungs and the cellular membrane that covers the greater part of the body, as well as with the whole cavity of the body, but that, by reason of some valvular contrivance, the skin could not be artificially inflated through the lungs, although air would readily pass in the contrary direction. It is also clear, that there is no direct communication between the sides.

In order to examine this extraordinary structure, I made a longitudinal incision the whole length of the body, a little on one side of the keel, or what is commonly termed the breast-bone; by this means, the membrane that connects the skin to the body, and cuts off the communication between the sides, was easily examined; but nothing was observed, indicating that a communication could be effected, even at the will of the animal. On each side, nearly equidistant between this pectoral membrane and the back, is situated another longitudinal one, very similar to the last, but perforated; between this and the pectoral are about nine irregular transverse membranous septa, that hold the skin firmly to the body, having a free communication with each other. The skin is also furnished with a transparent cellular membrane, the cells being regularly perforated, close to the base of each feather. At the upper part of the breast is a large bag, which extends some way up the neck; this is attached to the skin by the septa of innumerable small cells, but no opening into this cellular bag could be discovered; the introduction, however, of a small pipe through the artificial aperture, clearly demonstrated a passage to the lungs, as the whole internal cavity of the body was inflated, and the air issued from the trachea. Upon opening this bag, the passage of communication with the internal parts appeared to be under the clavicles, as a thin perforated membrane was perceived at the bottom, leading to the thorax, not directly into the lungs, but near the part where the trachea divaricates, and afterwards communicating with the lungs. It could not, however, be discovered where the air could find a passage from the great magazine into the cellular bag, and yet there is every reason to conclude that at this part some valvular passage exists.

Pursuing my researches, I observed, at the bottom of each lobe of the lungs, a considerable opening, for the passage of air into the cavity of the body; but what arrested my particular attention, was a wonderful provision of nature, for the protection of the vital parts, by guarding the whole viscera with a strong integument, that preserves them in a proper degree of moisture, and contributes to the due secretions for lubricating those parts, so essential to the functions of their delicate nature, which might otherwise be too quickly carried off, by the constant circulation of fresh air that nearly surrounds them; for this integument is held only by ligaments to the back and front, leaving all other parts free for inspired air. The liver and intestines are firmly attached to the surrounding integument; the heart is enveloped by a similar covering, which is only partially connected to the common one.

In the trachea nothing very remarkable occurs, except two small glands about the size of a pea, at the lower extremity *. The tongue is so ex-

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* It may not be improper to remark, that much important matter in the science of ornithology, may yet be expected, from a strict attention to the *trachea* of different birds. Dr Latham has paved the way to this discrimination of species, by his excellent paper on the subject, given in vol. iv. of the *Transactions of the Linnean Society;* but as much remains to be done, much may be expected, through the medium of the Wernerian Society, towards discriminating some of the northern birds, which as yet are much in obscurity. In the *Berlin Trans.* vols. iii. and iv., figures are given of the *trachea* of *Mergus Merganser,* and *Mergus Castor,* that are so essentially different, as to leave no doubt that the birds from which they were extracted, are actually distinct; for in these, not only a difference is observable in the labyrinth, but the trachea of the former has two enlargements, whereas the latter has only one.

How this is to be reconciled with the account related by Mr Simmonds, in vol. viii. of the *Linnean Transactions,* is left to the developement of the naturalists of North Britain, where these birds are frequently obtained.

tremely diminutive, as scarcely to be entitled to that denomination.

Has not the discovery of a labyrinth in *Mergus Castor*, of similar appearance to that of *M. Merganser*, been considered conclusive, without examining the rest of the trachea; or may not the female *Merganser* resemble in plumage both the sexes of the *Castor?* Has any one yet observed a bird in the plumage of *M. Merganser*, to be a female; and are we certain that the young male Mergus serrator, in its immature plumage, has not been confounded with these, since it has been ascertained, that that species is furnished with one enlargement in the trachea? If *M. Merganser*, in its immature state, should resemble in plumage *M. Castor*, the trachea of the young males would undoubtedly be similar to the adults, and we should be led still to look for a distinct species in a similar dress, with one enlargement in the trachea, as figured in the *Berlin Transactions*. It is also related by Mr Simmonds, that two specimens of *M. Merganser*, and two of *M. Castor*, now at Edinburgh, have only eighteen feathers in the tail. Those in my museum differ in this respect; the former has certainly that number, but the latter has twenty: this specimen I obtained fresh, and being a female, it was destitute of labyrinth.

It is much to be wished, that this subject may be more minutely investigated by those, who, from situation, may have more frequent opportunity; for, so rare are these birds become, in the southern parts of the kingdom, that, in the course of nearly thirty years collecting, I never obtained but the single specimen before mentioned, in a recent state.

The clavicles, or what is commonly called the merry-thought, which is usually affixed to the point of the keel of the breast-bone by a ligament, is, in the gannet, so firmly united, as to appear a part of it.

The very singular structure of this bird, so widely different from any that had before come under examination, could not surprise me more, than the discovery of a new and singular insect found to inhabit the cellular membrane attached to the skin. It is well known, that the species of *Vermes intestinales*, found to inhabit almost all the internal parts of animals possessed of a red circulating fluid, are extremely numerous, and that many others are not wholly destitute of them; but no instance, to my recollection, has been authentically proved, of a true insect having been observed, constantly to inhabit and propagate in a similar situation. A description and figure of this singular species of insect accompanies this paper.

Those who have had an opportunity of examining a great variety of birds, will have noticed the great difference in the general construction of the body, and in particular the abdominal parts, of the aquatic tribes; and doubtless will have observed how much more capable they are of enlarging the cavity of the body than land birds, and by that means are enabled to contain a much larger supply of air, so essential to the vital principle under peculiar circumstances, in order to support life with ease, without continued respiration, as in long submersion. But in order to derive the most ample advantage from so curious a conformation, a free circulation of the confined air must be carried on through the lungs, in order to supply vital energy, by the absorption of oxygen which is absolutely necessary to the existence of animals; thus, by passing and repassing through the lungs, the duration of submersion may be greatly extended, beyond what would result from simple pulmonary inspiration.

From the attachment of the lungs of a bird to the ribs and backbone, they are not capable of much distension, consequently can contain a very small portion of air; if, therefore, some extraordinary, or peculiar means, different from what is found to obtain in the class *Mammalia*, had not been given it, respiration must have been extremely quick and laborious, to supply the blood with that vital principle which is furnished by the decomposition of the air in these organs. Besides, by so small a portion of air as the lungs of a bird would alone contain, their voice must have been so extremely weak, as to be wholly useless to many, whose active, restless, and migratory life renders it absolutely necessary that their cry should be strong, in proportion to quick transportation from one place to another, in order that those of the same species should discover each other at a very considerable distance, especially by night. To obviate, therefore, the difficulty of the former, and to produce the desired effect of the latter, nature has been abundantly kind in providing this class of animals with a passage from the lungs, to a capacious magazine for air, not only for the purpose of temporary respiration, but as a kind of reservoir for certain exigencies; and in particular, that of supplying the instrument of sound with a sufficient quantity of it to be expelled with force through the larynx.

No one who has a previous knowledge of the size and construction of the lungs, can have observed the great exertion of a cock in the act of crowing, without being convinced, that the air, requisite for so strong and continued a sound by one expiration, could not be contained in that part.

If a duck or a goose is attended to when the usual cry is emitted, it will be evident, that the pressure of the abdomen propels the air which is therein contained, with much force into the anterior part of the body, which, with what is there already not being able to escape through the trachea, not only inflates the cellular membrane about the breast to an unusual size, but, by compression, rushes with violence through the larynx, and produces a sound more or less intense, in proportion as the muscles are more or less exerted.

Although this contrivance is so absolutely necessary to the existence of every species of bird, it is not immediately obvious for what particular purpose the property of inflation is so much further extended than usual in the gannet. We should not expect to find this power of inflating the skin, peculiar to those who obtain their subsistence by diving, because, in the act of immersion, such power could not be exerted without obstructing that operation; and it is obvious, that the air contained within the cavity of the body, is sufficient for all the ordinary purposes of seeking their prey under water.

From what has been already observed, it will not be unreasonable to conclude, that the gannet is endowed with such singular properties, for very different purposes than that of long and continual immersion. It cannot be doubted, but such a power of inflation must contribute greatly to lessen the concussion in its rapid descent upon the water, in order to seize its prey: besides, as the enlargement of the surface without materially adding to the specific gravity, must greatly contribute to its buoyancy both in air and water, it is well adapted for residing in the midst of the most tempestuous sea, floating on its surface in perfect security, and following those shoals of fish, on which depends its whole existence: thus, when all others are compelled to seek shelter in bays and creeks, the gannet is enabled to brave the severest weather in all seasons, without attempting to near the shore.

This contrivance may also be of the most important service to an animal which is constantly exposed, even in the most inclement season, and cannot quit its station without starving: nothing could possibly conduce more to its security against intense cold, or be better adapted to preserve the necessary temperature of animal-heat, than this intermediate body of air between the skin and the body, since that element is found to be a non-conductor of heat. Upon this principle, what animal can be more securely protected against cold, or retain its vital heat so effectually as the gannet, or such birds as are almost surrounded with a body of confined air, divided by cells, and intersected by membranes between the skin and the body, and that skin so amply covered with a light porous substance, filled also with air, and impervious to water * ?

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* The Gannet is capable of containing about three full inspirations of my lungs, divided into nearly three equal portions, the cellular parts under the skin, on each side, holding nearly as much as the cavity of the body. Now, as a full or extraordinary expiration of the human lungs has been considered to occupy a space of about sixty cubic inches, (Phil. Trans. vol. 69. p. 349.), so the gannet is capable of containing not less than 180 cubic inches of air at one time, subject to the will of the bird, under certain impressions.

Description of the Insect which inhabits the cellular membrane of the Gannet.

Ovate-oblong, smooth, glossy, white, with eight short legs, furnished with several joints, and terminated by bristles; two on each side approximating, and near to the anterior end; the others similarly disposed, about one-third of its length from the posterior end: of the posterior legs, the hindmost pair is furnished with a very long bristle, the other pair usually with two; the anterior legs possess several bristles each. No other appendages were discernible under the best constructed microscope, not even the mouth or eyes could be clearly ascertained; but beneath, at the anterior end from whence the fore-legs arise, there are four light depressions, surrounded by dark lines, in the two hindmost of which is a dark spot, but these had not the appearance of eyes: behind this part, is usually a fold in the skin, at which place there is an independent motion: the feet are also observed to be in continual alternate motion, while under the microscope.

Size about that of *Acarus siro*, or cheese-mite.

Pl. VII. Fig. 1. Under part.
2. Upper part.
3. Side view.
(All greatly magnified).

As far as I have hitherto observed, this insect is peculiar to the gannet, and does not appear to inhabit any other part than the cellular membrane: in some subjects, it is found in prodigious abundance, together with the ova;

and no instance has occurred in which it has not appeared more or less in every specimen dissected.

To class this insect with any of the Linnean genera, is impossible; nor am I acquainted with any genus, in the arrangement of any of the more modern systematic writers, in which it could with propriety be placed. It appears to be more nearly allied to *Acarus* than to any other; but the want of eyes, proboscis, or sucker, and palpi, will not admit of connection; the situation, too, of the legs, seem to be characteristic. Under these circumstances, I propose giving it a distinct place in the system of nature, under the title of CELLULARIA *Bassani*, with the following generic characters: Head, thorax, and abdomen united: No eyes, antennæ, palpi, nor proboscis: Legs eight, the four posterior remote from the four anterior: Feet unarmed, but furnished with bristles.

Before I conclude this paper, it may be proper to remark, that the gannet, like all other birds, is not destitute of some species of *pediculus* that inhabit the feathers. But as the insects of this very numerous genus are so extremely similar, that they have been considered distinct, only from the circumstance of having been found on different animals, it appears useless to perplex science with a catalogue of names without specific distinction. That which inhabits the gannet, appears to be the same as those found on

Fig. 1.

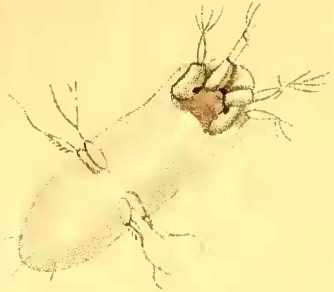
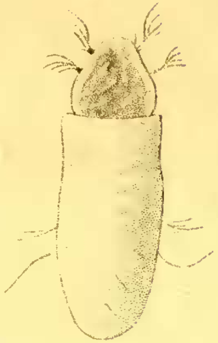


Fig. 2.



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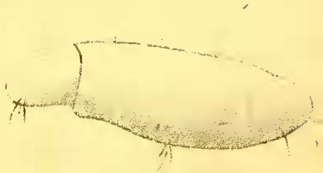

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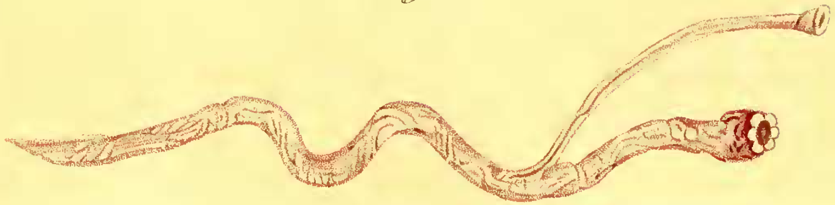

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